we also found that thrombocytopenia was associated with an increased risk of mortality.\(^1\)

Even though we found that thrombocytosis was associated with poor outcomes, Georges and colleagues did not find this association in their population of CAP patients. The authors indicated that our finding of an association between elevated platelet count and poor outcomes “could be explained by the moderate severity of CAP” in the patients in our series, with only 17% of these patients requiring ICU admission. Based on this observation, we may speculate that a low platelet count, being a marker of severe sepsis, predicts poor outcomes in patients with CAP in the ICU. On the other hand, an elevated platelet count may predict poor outcomes in patients with CAP in the absence of severe sepsis. In these patients, platelet-induced thrombus formation may play a role in their clinical outcomes. Using the data they presented, Georges and colleagues stated that in patients with thrombocytosis, cause of death was mostly related to complications of ICU stay or comorbidity. It is interesting that in these patients the majority of deaths were likely related to complications of ICU stay or comorbidity. It is interesting that in these patients the majority of deaths were likely related to thrombus formation because patients died of cerebrovascular ischemia, mesenteric ischemia, or myocardial infarction. We published an association of acute myocardial infarction and poor outcomes in hospitalized patients with CAP.\(^2\) Because platelet-induced thrombus formation may be amenable to treatment, further research is necessary to determine if a causal association exists among CAP, elevated platelet count, thrombus formation, organ ischemia, and clinical outcomes.

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How To Measure Lung Volume?

To the Editor:

In their recent article in CHEST (May 2010), O’Donnell et al\(^1\) report data on total lung capacity (TLC) in 132 patients with airflow obstruction from three hospitals. TLC measured using plethysmography was significantly larger than both TLC of helium (He) and TLC derived from CT scan measurements.

The CT scan is a new method for measuring lung volume. One would expect that the authors, before applying it to patients with airflow obstruction, would compare it with established methods in healthy subjects. Surprisingly, the authors provide practically no information on its validity. General considerations are not a substitute for evidence.

Their findings may be explained by an underestimation of lung volumes using the CT scan method resulting from submaximal inspiration in the supine position. Indeed, vital capacity was not measured in both sitting and supine positions. It is lower in the latter position compared with the former. At one hospital, with patients in the supine position, lung volume was monitored, but not measured, spirometrically during CT scan measurements. At another hospital, “subjects were read instructions from a prepared script.” At a third, “subjects were well practiced in the procedure.”

Measurements of lung volumes were done at three different hospitals—one across the ocean—with three different sets of equipment and with at least three different technicians. No preliminary validation of the accuracy of the measurements with each set of equipment and no comparison of the performances of the different technicians were done, with either regular quality controls and biologic controls. These methodologic problems affect the credibility of the arguments of the authors.

In patients with moderate to severe airflow obstruction, lung spaces are closed. The volume of these spaces is measured using plethysmography. It should be also measured using CT scans, but not using He dilution. Surprisingly, the authors report quite similar results for CT scans and He dilution.

The authors tend to discredit the plethysmographic method, stating, “With the assumption that Plethysmography was accurate....Medical texts began to reflect the conclusion that TLC was increased in various obstructive pathologies.” However, they omit mention that this conclusion was reached before 1982. Then and later, it was shown that plethysmography systematically overestimates lung volume in patients with airflow obstruction when they are panting at ≥2 Hz. However, panting at ≤1 Hz corrects the overestimation of lung volume.\(^2-4\) Furthermore, O’Donnell et al\(^1\) failed to mention data\(^2\) showing that interregional pressure differences in patients with airflow obstruction, a hypothesis they favor, are unlikely to explain errors in lung volume using plethysmography.

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**REFERENCES**


**Response**

To the Editor:

We thank Dr Stănescu for his correspondence regarding our recent publication in CHEST (May 2010). We have presented data that challenge conventional ideas about the plethysmographic method for measuring the resident volume of gas in the chest. Dr Stănescu’s critique is based largely on the traditional arguments defending that method over the helium (He) dilution method, and our rebuttal follows.

Unfortunately, the first sentence in his letter belies a careful reading of our report. Contrary to his claim that we studied 132 patients with airflow obstruction, we actually studied patients undergoing thoracic CT scan for a variety of indications, 79 with spirometrically documented obstruction and 53 with no evidence of obstruction.

He goes on to state, “The CT scan is a new method for measuring lung volume. One would expect that the authors, before applying it to patients with airflow obstruction, would compare it with established methods in healthy subjects.” As we report in the Abstract and “Results” section, “…there were significant within-subject differences in TLC [total lung capacity] by measurement technique among subjects with airflow obstruction, but not among those without airflow obstruction.”

Thus, we have established the comparability of CT scan with established techniques in subjects with normal lung function. Furthermore, radiographic techniques, including CT imaging, have been used for several decades to assess lung volume. The CT scan is not a “new method for measuring lung volume” as Dr Stănescu suggests.

The concern is raised that our “findings may be explained by the supine position to explain our data, it would require that TLC from supine position be less than that from a seated position only in those with obstruction and that the magnitude of the difference increase with severity of obstruction. We do not know of any evidence that this is the case, nor does Dr Stănescu cite any such evidence in defense of his criticism. The second is the very close correspondence between He dilution and CT scan lung volume among subjects with COPD (mean difference = 150 mL).” To argue that our results in those with obstruction are explained in one instance by underestimation of TLC by CT scan, measured with subjects supine, and in another instance underestimation by He, measured with subjects seated, would require the highly unlikely coincidence that the two underestimations are equal and independent of the severity of the obstruction. Dr Stănescu does not provide us with a hypothesis or data supporting the justification for his suggestion that this coincidence exists.

It is true that we did not attempt mutually standardized quality control among the three participating laboratories. However, all three sites were in university-affiliated hospitals and each laboratory adhered to American Thoracic Society/European Respiratory Society guidelines for pulmonary function test administration. We did monitor quality indicators, such as adequate He dilution time, plethysmographic panting frequency, linearity of plethysmographic box-pressure vs mouth-pressure plots, and test reproducibility. We are not sure how “one [laboratory] across the ocean” influences interlaboratory reliability, as Dr Stănescu seems to imply. To the extent that interlaboratory differences might affect results, we would expect less precision (more noise); therefore, a decreased probability of identifying any existing differences in line with our hypothesis (a conservative bias).

It is argued by Dr Stănescu that “In patients with moderate to severe airflow obstruction lung spaces are closed. The volume of these spaces is measured using plethysmography …[and]… CT scans, but not using He dilution.” However, patients with severe airways obstruction do not routinely have atelectasis; therefore, there must be ventilation of the regions subtended by closed airways, such as by collateral pathways. This ought to allow equilibration of He throughout the lung, if sufficient time is allowed. Furthermore, because closing volume increases with age and is in the range of functional residual capacity in people in their 60s, Dr Stănescu’s argument would predict that TLC measured by helium would be progressively less than TLC measured by plethysmography with aging. To our knowledge, this has not been observed.

We point out that “It was not until 1978 that Brown and Slutsky demonstrated frequency-dependent discrepancies in the measurement of thoracic gas volume among patients with asthma, a result suggesting that reported increases in TLC in asthma may have been largely an artifact of Pl eth.” Thus we do not “omit mention that this conclusion was reached before 1982.”

In response to the statement, “Then and later, it was shown that plethysmography systematically overestimates lung volume in patients with airflow obstruction when they are panting at ≥ 2 Hz.” However, panting at ≤ 1 Hz corrects the overestimation of lung volume, we acknowledged research demonstrating panting frequency dependence of plethysmographic TLC in airflow obstruction and the apparent accuracy of measures made at 1 Hz panting frequency. However, we went on to point out that none of the work on which the acceptability of 1-Hz panting is based included subjects with very severe obstruction. Many of our subjects did have an FEV1 substantially less than that reported for subjects in previous research on the effects of panting frequency. The largest by-technique differences we observed occurred among subjects with the most severe airflow obstruction.